




DEPARTMENT OF CARDIOVASCULAR PATHOLOGY

Renu Virmani, M.D.

Chairperson

Date of Appointment - 2 September 1984

MISSION

The Department of Cardiovascular Pathology supports the Armed Forces Institute of Pathology's three main mission facets—consultation, education, and research. The department studies the cardiovascular system and its pathological conditions as they relate to consultative cases, to the active military force, the Department of Veterans Affairs, and other federal or civilian agencies.

STAFF

Medical

Renu Virmani, M.D., Chairperson

Allen P. Burke, LtCol, USAF, MC, Associate Department Chairperson

Andrew Farb, M.D., Staff Cardiologist

(A) Steven Robinson, M.D., Staff Pathologist

Scientific

Wen Min Zuo, M.D., Research Scientist

(D) Silvio H. Litovsky, M.D., Callender-Binford Fellow

Frank Kolodgie, Ph.D., Research Scientist

Youhui Liang, M.D., Research Assistant

Hengjing Quyang, M.D., Research Assistant

Hedwig Avallone, Histology Supervisor

Russell M. Jones, Research Associate

Poonam Mannan, Research Associate

Patricia S. Wilson, Research Assistant

Rufus Seabron, Research Assistant

(D) Sue J. Lee, Research Assistant

Administrative

(D) John M. Groleau, MSGT, USAF, Administrative Officer

(D) Leslie A. Middleton, Department Secretary

CONSULTATION

During the past year, the staff pathologists of Cardiovascular Pathology reviewed 905 cases, of which 258 were surgical cases, 647 were autopsy cases, and an additional 32 cases were marked research only. Intramural consults consisted of surgical cases and autopsies. Our department caseload continues to increase; however, the majority of our cases now come from independent, collaborative conferences between different organizations and the staff of our department.

The department offers expert consultation on endomyocardial biopsies, cardiac tumors, congenital cardiac anomalies, AIDS-related cardiovascular diseases, cardiomyopathies, coronary heart disease, exercise-associated sudden cardiac death, and pathology of new interventions—balloon angioplasty, atherectomy, stents, and others. We continued to offer extramural consultations to the State of Maryland Medical Examiner's Office; the Cardiovascular Surgery and Cardiology Departments of Walter Reed Army Medical Center; the Uniformed Services University of the Health Sciences;

Vanderbilt University; the University of Maryland School of Medicine; and the Food and Drug Administration. In addition, a monthly conference is conducted at the Departments of Pathology, Cardiology, and Pediatric Cardiology at Georgetown Medical Center; Washington Hospital Center; VA Medical Center; Howard University; and the D.C. Medical Examiner's Office. Dr. Virmani serves as an ad hoc member on the study section of the Drug Abuse Biomedical Research Review Pharmacology II Subcommittee.

RESEARCH

We have continued our studies examining the role of estrogen on vascular smooth muscle cell migration. Dr. Kolodgie presented some of this work at the American College of Cardiology meeting in March 1995, and was selected first runner-up in the Young Investigators Award competition. A manuscript on estrogen and smooth muscle cell migration will be published in the *American Journal of Pathology*, in March 1996.

We have completed our project in collaboration with Dr. Alving (WRAIR) examining the effect of immunization with liposomal cholesterol on the metabolic regulation of serum cholesterol and development of atherosclerosis in the hypercholesterolemic rabbit. We found that in animals fed atherogenic diets containing 0.5% to 1.0% cholesterol, immunized rabbits demonstrated a reduction in total plasma cholesterol. Analysis of plaque area also showed significantly smaller lesions in vaccinated animals in most regions of the aorta. A manuscript regarding this work will be published in the *Journal of Clinical Medicine* in 1996.

We have completed our project in collaboration with the Cardiovascular Biological Research Group at the Lederle Laboratories in New York. This study reemphasizes the individual variability in response to cholesterol feeding in the rabbit and the type of lesion produced relative to the degree of cholesterol exposure. A manuscript regarding this work is in its second review (*Arteriosclerosis, Thrombosis, and Vascular Biology*). Such information regarding cholesterol exposure, lesion type, and individual biological variability to cholesterol will serve to establish a better model for the evaluation of therapeutic strategies designed to limit atherosclerotic progression in humans.

We have initiated studies to examine cell turnover during progression of atherosclerotic plaques in the Watanabe heritable hyperlipemic (WHHL) rabbit. We will assess cell division and death in intimal lesions as well as perform immunocytochemical studies to identify cell type. These experiments will continue throughout 1996.

Frank Kolodgie and Patricia Wilson have also continued their work on the effects of peripheral blood monocytes on human intimal smooth muscle cell proliferation. We have found that the blood monocytes decrease [3H]-thymidine uptake in smooth muscle cells. The mechanism does not appear to involve cell-cell contact, and we are in the process of screening conditioned medium from monocytes and monocytes in coculture with smooth muscle cells for growth regulatory cytokines. We are planning to submit an abstract to the American Heart Association fall meeting and complete the manuscript in 1996. We have collaborated with both Dr. Ross Gerrity and Dr. John Catravas from the Medical College of Georgia on projects involving the effects of blood monocytes on aortic endothelial cells. Dr. Gerrity, in collaboration with our department, has shown that arterial endothelial cells stimulate enhanced proliferation of blood monocytes; a manuscript describing these findings is in review. Dr. Catravas, in collaboration with our department, has shown that monocytes downregulate angiotensin converting enzyme and nitric oxide synthase activity in human aortic endothelium. Two manuscripts regarding this work are in press (*Arteriosclerosis, Thrombosis, and Vascular Biology*). We are hoping to submit a grant regarding our work in monocyte-endothelial and smooth muscle cell cocultures to the National Heart, Lung, and Blood Institute in October of 1996.

Drs. Farb, Burke, and Virmani have continued work exploring the pathology of sudden coronary death. The frequency of atherosclerotic plaque disruption and coronary thrombosis in sudden coronary death was reported (in *Circulation*) from a consecutive series of 90 hearts seen in consul-

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tation with the Office of the Chief Medical Examiner for the State of Maryland. In a follow-up study, 50 hearts with acute coronary thrombosis from individuals with sudden death were examined. While plaque ruptures of a lipid-rich plaque accounted for a majority of the cases, erosion of a smooth muscle cell-rich plaque was frequently encountered. These data were reported at the Scientific Sessions of the American College of Cardiology. In sudden death due to coronary thrombosis, moderate (not severe) atherosclerotic luminal narrowing is most frequently present. This finding is consistent with the clinical impression of cardiologists and was reported at the Scientific Sessions of the American Heart Association.

Research in coronary interventions for the treatment of atherosclerosis and approaches to restenosis continue in our department on both the basic and clinical level. Drs. Farb and Virmani have completed a study utilizing basic fibroblast growth factor linked to the mitotoxin saporin-6 to inhibit neointima formation after balloon carotid artery injury in the rat. Preliminary results were reported at the Scientific Sessions of the American College of Cardiology, and a manuscript is near completion. We have begun placing metallic stents in rabbits with a variety of coatings in an effort to reduce neointimal growth. Studies of coronary stenting in pigs, in collaboration with Dr. Andrew Carter of the Division of Cardiology at WRAMC, have shown the effects of the underlying plaque on the neointimal response and have demonstrated neointimal inhibition with radioactive stents. The first demonstration of coronary pathology following rotational atherectomy in humans was reported in the *American Heart Journal*. The association of clinical outcome with proliferative activity of coronary plaques obtained by percutaneous atherectomy was studied in collaboration with Dr. Allen Taylor of the Division of Cardiology at WRAMC and was reported in *Chest*.

We have studied the effect of estrogen on preconditioning in the rat global ischemic mode. Dr. Litovsky has studied the biochemistry for the measurement of high-energy phosphates in glycogen. The results show that chronic treatment of ovariectomized rats with estrogen affords mechanical recovery after global ischemia in addition to that afforded by preconditioning, an intervention known to improve resistance to ischemia. Results of the adenosine nucleotide pools are pending. In past experiments, when preconditioning was not studied, estrogen was found to maintain the adenosine nucleotide pools better than the placebo control group. The manuscript is being written.

Dr. Litovsky has reviewed the AFIP cases of giant cell myocarditis. Special effort was employed to differentiate these cases from cardiac sarcoidosis. In our experience, giant cell myocarditis is clinically and pathologically clearly different from cardiac sarcoidosis. The manuscript is being submitted for review.

Dr. Wen has continued to collaborate with Dr. Dichek and Dr. Anita Roberts at the NIH to study TGF b-1 using adenoviral vector mediated in vitro gene transfer. Optimization of in situ hybridization was accomplished by generating positive control tissues after delivery of a specific recombinant gene to cultured rat aortic smooth muscle cells. A manuscript entitled "Recombinant adenoviral vector mediated gene transfer in vitro: application for control tissue for in situ hybridization" has been completed.

Dr. Wen has used the rat carotid injury model to study the induction of TGF-b1 gene in the media of arteries without injury and after injury at times 0, 3 hr, 6 hr, 24 hr, 3 days, 7 days, 2 weeks, and 4 weeks. She has shown that expression of TGF-b1 in the media is gradually increased as early as 6 hr after balloon injury and reaches its peak at 2 weeks after injury. This time course shows positive correlation between smooth muscle cell proliferation and increased levels of TGF-b1 gene expression and TGF-b1 protein production in carotid balloon injured arteries. A manuscript, "Synthesis of transforming growth factor b1 by smooth muscle cells is correlated with neointimal proliferation: a time course study in a rat model of balloon angioplasty" is in preparation.

The study of in vivo TGF-b1 gene transfer was carried out in Dr. Dichek's laboratory at NIH, and we have performed the histologic examination. These studies show that TGF-b1 plays a central role in proliferation of smooth muscle cells in the neointima and media and in cell transformation. Deposition of extracellular matrix proteins in arteries occurred in vivo in medial and intimal cells at 28

days after endothelial TGF- β 1 transfer. The medial wall reverted back to a relatively normal state in 56 days.

Drs. Burke and Virmani completed the third series fascicle on "Cardiac Tumors," which is to be released in March 1996. It has 16 chapters and 273 illustrations and describes their experience with 450 primary cardiac tumors and cysts that were reviewed from the files of the AFIP from 1977 to 1992. Drs. Burke, Farb, and Virmani have also completed a book, *Surgical Pathology of the Heart and Blood Vessels*, which has 625 figures and 25 chapters. This book will be released by W. B. Saunders in January 1996.

The department continued its clinical research in the area of sudden cardiac death, complementing the large numbers of consults in this field that the department receives. In addition to Dr. Farb's studies on the morphology of atherosclerotic plaques in sudden cardiac death, Dr. Burke has submitted manuscripts on the role of cardiomegaly in plaque morphology in hypertensive and nonhypertensive sudden death, as well as a manuscript on conduction system findings in patients with mitral valve prolapse.

EDUCATION

This year we again held our annual course on "Congenital Heart Disease," which received excellent reviews and was attended by 25 participants. Dr. Virmani held a conference on "Current Concepts in Cardiovascular Diseases" in New Delhi, India. We also organized and participated in the Cardiology/Cardiovascular Conference with the Division of Cardiology at Walter Reed Army Medical Center and the Naval Medical Center. The professional staff of the Department of Cardiovascular Pathology lectured at the Uniformed Services University of the Health Sciences, the Naval Medical Center, Georgetown University, the University of South Alabama, and Vanderbilt University. In addition to lecturing and teaching outside of the Institute, the departmental staff also participated in resident training. During 1995, residents participated in department lectures and conferences and were instructed and critiqued by department pathologists. Dr. Virmani was invited to lecture at 21 meetings within the United States and overseas.

PRESENTATIONS

Dr. Virmani presented the following in 1995:

1. February 13, 1995. Advanced Cardiovascular Systems, Santa Clara, Calif. "Swine Atherosclerosis Model: ACS MULTI-LINK Stent Pathology" and "Pathology of Drug Delivery Stent in the Pig Model."
2. February 20-21, 1995. Cambridge Healthtech Institute's "Prevention of Reperfusion Injury," New Orleans, La. "Overview of Reperfusion Injury and Consequences" and chaired a session on "Overview of Reperfusion Injury" and panel discussion.
3. February 21-22, 1995. Cambridge Healthtech Institute's "Prevention of Restenosis," New Orleans, La. "Pathology of Human Restenosis with Comparison to Animal Models of Restenosis."
4. February 24, 1995. The Lazarus Group, Ritz-Carlton, Pentagon City, Va. "Pathophysiology of Cardiac Ischemia and Reperfusion."
5. March 11-17, 1995. United States and Canadian Academy of Pathology, Case Presentation, Cardiovascular Pathology Specialty Conference. "Surgical Pathology of Cardiac Masses."
6. March 19, 1995. Advanced Cardiovascular Systems, New Orleans, La. "Biodegradable Stent Pathology."
7. April 8, 1995. Student Symposium, American Registry of Pathology, Washington, D.C., "Better Medicine through Pathology."

8. May 3, 1995. Cardiology Grand Rounds, Ottawa Civic Hospital, Ottawa, Canada. "Pathology of Acute Coronary Syndromes" and "Pathology Slide Seminar."
9. June 6, 1995. Green Lane Hospital, Auckland, New Zealand. "Pathology of Coronary Interventions."
10. June 7, 1995. Wellington School of Medicine, Newton, Wellington, New Zealand. "Pathology of Coronary Interventions."
11. June 9, 1995. Christchurch School of Medicine, Christchurch, New Zealand. "Coronary Thrombosis and the Underlying Atherosclerotic Plaque."
12. August 3-4, 1995. National Institute on Drug Abuse, NIH, Bethesda, Md. "Pathobiologic Determinants of Cocaine-Associated Cardiovascular Disease in Humans."
13. August 15, 1995. Johnson & Johnson, Interventional Systems Co., Warren, New Jersey. "Pathology of b-particle Irradiated Stents Implanted in Swine Coronary Arteries."
14. September 4, 1995. XV European Congress of Pathology, Copenhagen, Denmark. "Sudden Death among Young Athletes with Emphysema on Atherosclerotic Heart Disease."
15. September 25-28, 1995. Congenital Heart Disease Review, Armed Forces Institute of Pathology, Washington, D.C., "Introduction to Congenital Heart Disease," "Congenital Lesions of the Mitral and Tricuspid Valves," and "Pulmonary Hypertension and Congenital Heart Disease."
16. September 28-29, 1995. The First Annual International Symposium on Local Cardiovascular Drug Delivery, Cambridge, Mass. "Human Applications: Pathology of Lesions."
17. October 2, 1995. University of South Alabama, Mobile, Ala. "Pathology Slide Seminar."
18. November 11, 1995. Arrow International, Dana Point, Calif. "Pathology of Pullback Atherectomy Specimens."
19. November 12, 1995. Advanced Cardiovascular Systems, Anaheim, Calif., "Biodegradable Stent Pathology."
20. November 13, 1995. Isostents, Anaheim, Calif., "Pathology of b-particle Irradiated Stents Implanted in Swine Coronary Arteries."
21. December 3-7, 1995. All India Institute of Medical Sciences, New Delhi, India, course director, "Current Concepts in Cardiovascular Diseases," and lectures on "Pathology of Atherosclerotic Ischemic Coronary Disease" and "Pathology of Aortic Aneurysms."
- Dr. Kolodgie presented on "Estradiol-17 β Attenuates Directed Migration of Vascular Smooth Muscle," at the American College of Cardiology 44th Annual Scientific Session, Young Investigators Award Competition, New Orleans, Louisiana, April 1995.

Dr. Farb presented on "Pulse Dosing of Recombinant Basic Fibroblast Growth Factor Linked to Saporin Mitotoxin Suppresses Neointimal Proliferation after Balloon Injury" and on "Ulceration of Smooth Muscle Cell-rich Plaques: A Frequent Cause of Coronary Artery Thrombosis That Is Not Mediated by HLA-DR Expression" at the Scientific Sessions, American College of Cardiology; March 1995. He also presented "Moderate Atherosclerosis Is a Frequent Finding in Sudden Death Due to Coronary Thrombosis" at the Scientific Sessions of the American Heart Association, November 14, 1995. At the "Current Concepts in Cardiovascular Diseases" in New Delhi, India, he presented "Pathophysiology of Restenosis and Coronary Interventions," "Pathology of Valvular Heart Disease," and "Coronary Artery Disease in Sudden Cardiac Death."

Dr. Burke presented "Dysplasia of the Artery to the Atrioventricular Node and Mitral Valve Prolapse" and lectured for the Cardiovascular Pathology Specialty Conference, at the US-Canadian Academy of Pathology Conference, in Toronto, Canada. He lectured on "Cardiac Tumors and Hypertrophic Cardiomyopathy" at the Current Concepts in Cardiovascular Diseases, All India

Institute of the Medical Sciences, New Delhi, India, December 1995. He also lectured at the Osler Institute Pathology Review Course, Annapolis, Md., April 1995, and Chicago, Ill., May 1995. He lectured at Walter Reed Army Medical Center and George Washington Medical Center for pathology residents training in cardiovascular pathology, and lectured to medical students at the Uniformed Services University of the Health Sciences in Bethesda, Md., and at Georgetown University.

PUBLICATIONS

Journal Articles

1. Kolodgie FD, Farb A, Virmani R. Pathobiologic determinants of cocaine-associated cardiovascular syndromes. *Hum Pathol.* 1995;26:583-586.
2. Alving CR, Swartz GM, Wassef NM, Herderick EE, Virmani R, Kolodgie FD, Matyas GR, Ribas JL, Kenner JR, Cornhill JF. Prospects for an anticholesterol vaccine. *Clinical Immunotherapy.* 1995;3:409-414.
3. Duflou J, Virmani R, Rabin I, Burke A, Farb A, Smialek J. Sudden death as a result of heart disease in morbid obesity. *Am Heart J.* 1995;130:306-313.
4. Hong MK, Wong SC, Farb A, Mehlman MD, Virmani R, Barry JJ, Leon MB. Localized drug delivery in atherosclerotic arteries via a new balloon angioplasty catheter with intramural channels for simultaneous local drug delivery. *Cathet Cardiovasc Diagn.* 1995;34:263-270.
5. Farb A, Roberts D, Pichard AD, Kent KM, Virmani R. Coronary artery morphology following coronary rotational atherectomy: insights into mechanisms of lumen enlargement and embolization. *Am Heart J.* 1995;129:1058-1067.
6. Farb A, Tang AL, Burke AP, Sessums L, Liang Y, Virmani R. Sudden coronary death: frequency of active coronary lesions, inactive coronary lesions, and myocardial infarction. *Circulation.* 1995;92:1701-1709.
7. Duflou J, Virmani R, Rabin I, Burke AP, Farb A, Smialek J. Sudden death due to heart disease in morbid obesity. *Am Heart J.* 1995;130:306-313.
8. Schulman FY, Farb A, Virmani R, Montali R. Fibrosing cardiomyopathy in captive western lowland gorillas (*Gorilla gorilla gorilla*) in the United States: a retrospective study. *Zoo Wildl Med.* 1995;26:43-51.
9. Hong MK, Wong SC, Mintz GS, Farb A, Kent KM, Pichard AD, Satler LF, Popma JJ, Sidawy A, Virmani R, Leon MB. A modified directional atherectomy catheter for resection of calcified atherosclerotic plaque. *Coron Artery Dis.* 1995;6:335-339.
10. Taylor AJ, Farb A, Angello DA, Burwell LR, Virmani R. Proliferative activity in coronary atherectomy tissue: clinical, histopathologic, and immunochemical correlates. *Chest.* 1995;108:815-820.
11. Schulick AH, Newman KD, Virmani R, Dichek DA. In vivo gene transfer into injured carotid arteries: optimization and evaluation of acute toxicity. *Circulation.* 1995;91:2407-2414.
12. Burke AP, Sobin LH, Virmani R. Localized vasculitis of the gastrointestinal tract. *Am J Surg Pathol.* 1995;19:338-349.
13. Schachtner SK, Rome JJ, Hoyt RF, Newman KD, Virmani R, Dichek DA. In vivo adenovirus-mediated gene transfer via the pulmonary artery of rats. *Circ Res.* 1995;76:701-709.
14. Schulick AH, Dong G, Newman KD, Virmani R. Endothelial-specific in vivo gene transfer. *Circ Res.* 1995;77:475-485.
15. Strong JP, for the Pathobiologic Determinants of Atherosclerosis in Youth (PADY) Research Group. *Clin Chem.* 1995;41:134-138.
16. Newman KD, Dunn PF, Owens JW, Schulick AH, Virmani R, Sukhove G, Libby P, Dichek DA. Adenovirus-mediated gene transfer into normal rabbit arteries results in prolonged vascular cell activation, inflammation and neointimal hyperplasia. *J Clin Invest.* 1995;96:2955-2965.

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In addition, 11 articles are in preparation or in press.

Book chapters

1. Virmani R, Burke AP, Farb A. Problems in forensic pathology. In: Gimbrone MA, Schoen FJ, eds. *Cardiovascular Pathology: Clinicopathologic Correlations and Pathogenic Mechanisms*. Baltimore, Md: Williams & Wilkins; 1995:173-193.
2. Rottman G, Farb A, Burke A, Virmani R. Cardiovascular manifestations of systemic lupus erythematosus. In: Antonovych TT, ed. *Pathology of Systemic Lupus Erythematosus*. Washington, DC: Armed Forces Institute of Pathology, American Registry of Pathology; 1995:111-131..
3. Alving CL, Schwartz GM, Wassef NM, Herderick EE, Virmani R, Kolodgie FD, Matyas GR, Ribas JL, Kenner JR, Cornhill JF. Vaccination against cholesterol: immunologic modulation of diet-induced hypercholesterolemia and atherosclerosis in rabbit. In: Woodford FP, Davignon J, Sniderman A, eds. *Atherosclerosis X*. New York, NY: Elsevier Science B.V.; 1995:944-947.
4. Gerrity RS, Antonov, Munn DH, Bell FP, Virmani R, Kolodgie FD. The macrophage in human and experimental atherosclerosis. In: Woodford FP, Davignon J, Sniderman A, eds. *Atherosclerosis X*. New York, NY: Elsevier Science B.V.; 1995:577-581.

In addition, 10 chapters are scheduled for publication in 1996.

Abstracts

1. Burke AP, Farb A, Tang AL, Rabin I, Virmani R. Dysplasia of the artery to the atrioventricular node and mitral valve prolapse. *Mod Pathol*. 1995;8:30A.
2. Burke AP, Farb A, Tang A, Virmani R. Effect of systemic hypertension on atherosclerotic plaque morphology in sudden cardiac death. *Mod Pathol*. 1995;8:31A.
3. Farb A, Tang AL, Burke AP, Liang Y, Mannan P, Smialek J, Virmani R. Ulceration of smooth muscle cell-rich plaques: a frequent cause of coronary artery thrombosis that is not mediated by HLA-DR expression. *J Am Coll Cardiol*. February 1995:167A.
4. Litovsky SH, Farb A, Rabin I, Burke AP, Smialek J, Virmani R. Effect of atherosclerosis and race on coronary dimensions in young males. *Mod Pathol*. 1995;8:34A.
5. Pestaner JP, Mullick FG, Virmani R. Comparison of toxic cardiomyopathy and dilated cardiomyopathy by light microscopy. *Mod Pathol*. 1995;8:35A.
6. Farb A, Lee SJ, Mohler M, Cook J, McDonald J, Virmani R. Pulse dosing of recombinant basic fibroblast growth factor linked to saprocin mitotoxin suppresses neointimal proliferation after balloon injury. *J Am Coll Cardiol*. February 1995:51A.
7. Burke AP, Farb A, Tang AL, Rabin I, Virmani R. Dysplasia of the atrioventricular nodal artery in patients with mitral valve prolapse and sudden death. *J Am Coll Cardiol*. February 1995:167A.
8. Laird J, Carter AJ, Kufs WM, Hoopes T, Farb A, Nott S, Fischell DR, Virmani R, Fischell T. Inhibition of neointimal proliferation with a beta particle emitting stent. *J Am Coll Cardiol*. February 1995:287A.
9. Farrell SK, Rome JJ, Virmani R, Newman KD, Hoyt R, Dichek DA. In vivo adenovirus-mediated gene transfer via the pulmonary artery of rats. *J Am Coll Cardiol*. February 1995:323A.
10. Farb A, Burke AP, Liang Y, Smialek, Virmani R. Moderate atherosclerosis is a frequent finding in sudden death due to coronary thrombosis. *Circulation*. 1995;92(suppl):I-340,1620.
11. Burke AP, Farb A, Liang Y, Smialek J, Virmani R. Hypertension and coronary artery morphology in sudden death. *Circulation*. 1995;92(suppl):I-746, 3588.

GOALS

The goals for the Department of Cardiovascular Pathology in 1996 are:

1. To provide expert and timely consultation on extramural and intramural cases. We hope to reduce the turnaround time for surgical cases to less than 3 days, and for autopsies to 10 days. Autopsies require more detailed description, extensive sectioning, and special handling for



coronary cases as well as for conduction system studies.

2. To hold short courses at pathology meetings, including the Annual Academy of Forensic Pathology, USCAP, and ASCP.
3. We are making extensive efforts to be the best known laboratory for pathology of stents in the world.
4. We continue to make inroads into the understanding of atherosclerotic coronary heart disease and hope to develop new techniques for a better understanding of the role of cytokines, growth factors, and proteolytic enzymes in the causation of coronary thrombosis.
5. We hope to determine the best method for drug delivery to coronary arteries to reduce restenosis, specifically endovascular versus perivascular drug delivery.